Project Report: Habitability of Jupiter's Galilean Moons

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Project Progress

The following progress has been made in connection with establishing the viability of habitable environments in the solar system with emphasis on geodynamics:

1: ***Coupled orbital–rotational–viscoelastic dynamics of the Galilean satellites***
We have developed and tested a code to solve the complete orbital–rotational–viscoelastic dynamics of a deformable body. We have begun by investigating the behavior of rigid bodies, finding that this "well studied" problem was not well understood, and that existing studies were inconsistent with each other. A manuscript has been submitted to *Icarus* . The code for deformable bodies is completed, and has been cross–checked with a code based on a different approach.

2: ***Heat transport in tidally heated bodies***
The generation of heat by tidal dissipation is calculated from the solution of the equations of motion for a layered viscoelastic body, and this is coupled to parameterized heat transport equations. Work on Europa's icy shell has revealed that tidal dissipation cannot lead to melting near the surface of the shell, only near its base. These results were presented at "Workshop on Europa's Icy Shell" and at the Spring 2004 American Geophysical Union (AGU) conference.

3: ***Detection of tidal flexure on Europa by inSAR***
A feasibility study was carried out to determine if an orbiting spacecraft could detect the tidal flexing of fractures on Europa using ***inSAR*** . (Manuscript in Press)

4: ***Martian Obliquity History***
The evolution of the spin axis of Mars is controlled by its shape and by the history of its orbit around the Sun. We have developed a code to model the evolution of a deformable Mars and follow its obliquity through time. Results so far indicate that, for reasonable viscosities, deformation may be an important controlling factor in the history of Mars' obliquity.

5: ***Participation in the Jupiter Icy Moons Orbiter (JIMO) Science Definition Team***
William Moore served on the Science Definition Team for the Jupiter Icy Moons Orbiter, NASA's next mission to the moons of Jupiter.

Highlights

- Tidal heating does not lead to melting in icy shells, except near the bottom, and is therefore not a likely explanation for cryovolcanic features on the icy moons of Jupiter.

Roadmap Objectives

- ***Objective No. 1.1:*** Models of formation and evolution of habitable planets
- ***Objective No. 2.2:*** Outer Solar System exploration